

PATENT  
8020-1021-1

**IN THE U.S. PATENT AND TRADEMARK OFFICE**

In re application of: Yoshihira MATSUBARA

Appl. No.: Unassigned

Filed: July 23, 2003

Title: SEMICONDUCTOR DEVICE WITH AMORPHOUS METAL  
FILM BETWEEN BARRIER METAL

**PRELIMINARY AMENDMENT**

Assistant Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

July 23, 2003

Sir:

Prior to examination on the merits, the following amendments and remarks are respectfully submitted in connection with the above-identified application.

**Amendments to the Specification** begin on page 2 of this paper.

**Remarks/Arguments** begin on page 6 of this paper.

AMENDMENTS TO THE SPECIFICATION:

Please amend the specification by inserting before the first line thereof the following:

--This application is a division of co-pending Application No. 09/290,259, filed on April 13, 1999, the entire contents of which are hereby incorporated by reference.--

Please replace the paragraph beginning at page 1, line 19, with the following rewritten paragraph:

--In semiconductor devices typified by large scale integrated circuits (LSIs) such as memories, microprocessors and the like, the more the devices increase in integration density, ~~they becomes~~ the finer in dimension, and, therefore finer ~~in their dimension~~ in their individual semiconductor regions forming various elements. Further, in forming a plug electrode or a buried wiring in each of these semiconductor regions, a contact hole, a via hole, or a trench designed for a buried wiring formed in the interlayer insulation film becomes finer in diameter. In addition, since the wiring density increases, a so-called multilevel interconnection technique for producing a multi-layer wiring stacked in the width direction of a semiconductor substrate has been developed.--

Please replace the paragraph beginning at page 5, line 7, with the following rewritten paragraph:

--Further, in the above-mentioned conventional technique, adhesion between the tantalum-base metal and an interlayer insulation film disposed thereunder is also poor. The reason why it is so seems to be the same as that of the above.--

Please replace the paragraph beginning at page 5, line 14, with the following rewritten paragraph:

--In view of the above problems, it is an object of the present invention to provide a semiconductor device and a manufacturing method of the same, wherein a connection portion of a ~~tantalum-base~~ tantalum-based metal as a barrier metal film with a copper wiring is improved in adhesion to prevent the copper wiring from peeling off, so that the semiconductor device is improved in reliability.--

Please replace the paragraph beginning at page 5, line 20, with the following rewritten paragraph:

--According to a first aspect of the present invention, there is provided a semiconductor device having a ~~construction,~~ formed construction in which is an interlayer insulation film ~~which~~ is provided with a contact hole, a via hole, or with a trench designed for a buried wiring on a semiconductor substrate, wherein the contact hole, the via hole, or the trench designed for the buried wiring is filled with copper or a ~~copper-base~~ copper-based conductive material through a barrier metal film

made of a ~~tantalum-base~~ tantalum-based metal to form a plug electrode or the buried wiring, the improvement wherein:

an amorphous metal film containing at least ~~the~~ tantalum and copper is formed between the barrier metal film and the conductive material.--

Please replace the paragraph beginning at page 10, line 10, with the following rewritten paragraph:

--~~Re: First Embodiment:~~

Fig. 1 shows a semiconductor device of a first embodiment of the present invention. Figs. 2 to 8 sequentially show a series of process steps of a manufacturing method of the semiconductor device of the present invention in the order of these process steps.--

Please replace the paragraph beginning at page 11, line 12, with the following rewritten paragraph:

--The amorphous metal film 7 contains at least tantalum and copper. This amorphous metal film 7 has ~~its~~ a minimum film thickness ~~be of~~ of approximately 20 angstroms, and is capable of being formed over substantially the entire area of the tantalum film 6. Namely, the amorphous metal film 7 ~~on this case~~ is capable of being formed so as to have ~~its~~ a maximum film thickness ~~be of~~ of approximately 500 angstroms. Further, the tantalum oxide film 11 contains tantalum compounds represented by "TaSi<sub>x</sub>" and "TaN<sub>x</sub>" in addition to tantalum compounds represented by "TaO<sub>x</sub>".--

Please replace the paragraph beginning at page 16, line 4, with the following rewritten paragraph:

--As described above, in this embodiment of the present invention in construction, since the amorphous metal film 7 is formed between the tantalum film 6 serving as a barrier metal film and, the copper buried wiring 8, the tantalum film 6 is brought into more intimate contact with the copper buried wiring 8. Due to this, it is possible to prevent the copper buried wiring 8 from peeling off, which improves the semiconductor device of the present invention in reliability. Due to this, it is possible for the present invention to produce a high-performance semiconductor device in an easy manner.--

Please replace the paragraph beginning at page 16, line 21, with the following rewritten paragraph:

~~--Re: Second Embodiment--~~

Fig. 12 shows the semiconductor device of a second embodiment of the present invention. Figs. 13 to 15 are process charts following the order of process steps, illustrating the manufacturing method of the semiconductor device.--